

ARTICLE

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An analysis of fatal occupational injuries at road construction sites, 2003–2010

From 2003 to 2010, 962 workers were killed at road construction sites. Nearly half of these deaths resulted from a vehicle or mobile equipment striking the worker. Using data from the Bureau's Census of Fatal Occupational Injuries, this analysis categorizes workers by whether they were working at or passing through the road construction site when fatally injured.

The annual number of occupational road construction site deaths garners much attention among policymakers, safety professionals, and others. From 2003 to 2010, more than 7,000 deaths were reported at road construction sites.¹ Over the same period, 962 workers died from injuries incurred at a road construction site.² (See tables 1 and 2.) Even as overall fatal workplace injuries decreased, fatal workplace injuries at road construction sites remained relatively constant.

Table 1. Fatal occupational injuries at road construction sites and at all sites, 2003–2010

Year	2003	2004	2005	2006	2007	2008	2009	2010	2003–2010
Road construction	110	119	165	139	106	101	116	106	962
All sites	5,575	5,764	5,734	5,840	5,657	5,214	4,551	4,690	43,025
Road construction as a percentage of all fatal occupational injuries	2.0	2.1	2.9	2.4	1.9	1.9	2.5	2.3	2.2

Note: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

Source: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

Table 2. Fatal occupational injuries at road construction sites, 2003–2010

Characteristic	Fatal occupational injuries
Total	962
State of Incident	
Texas	104
Florida	66
Illinois	50
Pennsylvania	49
Georgia	45
California	41
Employee Status	
Wage and salary ⁽¹⁾	932
Self-employed ⁽²⁾	30
Gender	
Men	931
Women	31
Age	
18–19	18
20–24	64
25–34	172

Characteristic	Fatal occupational injuries
35–44	225
45–54	267
55–64	168
65 and older	47
Race or ethnic origin ⁽³⁾	
White, non-Hispanic	662
Black or African American, non-Hispanic	103
Hispanic or Latino	182
Event ⁽⁴⁾	
Transportation	692
Worker struck by vehicle, mobile equipment	443
Highway/nonhighway incident	244
Contact with objects and equipment	148
Struck by falling object	51
Exposure to harmful substances or environments	57
Contact with electric current	39
Falls	50
Occupation ⁽⁵⁾	
Construction laborers	274
Truck drivers, heavy and tractor trailer	124
First-line supervisors, construction	79
Operating engineers	76
Highway maintenance workers	59
Paving, surfacing, and tamping equipment operators	48
Crossing guards	37
Industry ⁽⁶⁾	
Private sector	827
Construction	626
Highway, street, and bridge construction	471
Utility system construction	47
Site preparation contractors	46
Transportation and warehousing	89
Truck transportation	83

Characteristic	Fatal occupational injuries
Government ⁽⁷⁾	135
State government	61
Local government	74

Notes:

(1) May include volunteers and workers receiving other types of compensation.

(2) Includes self-employed workers, owners of unincorporated businesses and farms, paid and unpaid family workers, businesses or members of partnerships and may include some owners of incorporated businesses or members of partnerships.

(3) Persons identified as Hispanic or Latino may be of any race. The racial categories shown exclude data for Hispanics and Latinos.

(4) Based on the BLS Occupational Injury and Illness Classification Manual.

(5) Occupation data from 2003 to the present are based on the 2000 Standard Occupational Classification system.

(6) Industry data from 2003 to 2008 are based on the 2002 North American Industry Classification System. Industry data from 2009 to the present are based on the 2007 North American Industry Classification System.

(7) Includes fatal injuries to workers employed by governmental organizations regardless of industry.

Note: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

Source: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

Previous analyses have focused on a general overview of fatal occupational injuries at road construction sites and on specific incidents that led to those injuries.³ This analysis will separate these deaths into fatalities incurred by those who were working at the road construction site and fatalities incurred by those who were simply passing through the road construction site. The analysis includes information that is available only from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) case narratives, which will be used to distinguish between these two groups of workers, each of which faces decidedly different hazards.⁴

Background

The Manual on Uniform Traffic Control Devices (MUTCD), published and maintained by the Federal Highway Administration, “defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic.”⁵

Section 6C.02, “Temporary traffic control zones,” defines a work zone as

an area of a highway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC [temporary traffic control] device.⁶

Sections 5G (“Temporary traffic control zones”) and 6 (“Temporary traffic control”) outline many aspects of setting up and maintaining road construction sites, including signage, channeling devices, flaggers, and worker safety. In particular, section 6D.03, “Worker safety consideration,” outlines five parameters for improving worker safety:

- A. Training—all workers should be trained on how to work next to motor vehicle traffic in a way that minimizes their vulnerability. Workers having specific TTC responsibilities should be trained in TTC techniques, device usage, and placement.
- B. Temporary Traffic Barriers—temporary traffic barriers should be placed along the work space depending on factors such as lateral clearance of workers from adjacent traffic, speed of traffic, duration and type of operations, time of day, and volume of traffic.
- C. Speed Reduction—reducing the speed of vehicular traffic, mainly through regulatory speed zoning, funneling, lane reduction, or the use of uniformed law enforcement officers or flaggers, should be considered.
- D. Activity Area—planning the internal work activity area to minimize backing-up maneuvers of construction vehicles should be considered to minimize the exposure to risk.
- E. Worker Safety Planning—a trained person designated by the employer should conduct a basic hazard assessment for the worksite and job classifications required in the activity area. This safety professional should determine whether engineering, administrative, or personal protection measures should be implemented. This plan should be in accordance with the Occupational Safety and Health Act of 1970, as amended, “General Duty Clause” Section 5(a)(1) - Public Law 91-596, 84 Stat. 1590, December 29, 1970, as amended, and with the requirement to assess worker risk exposures for each job site and job classification, as per 29 CFR 1926.20 (b)(2) of “Occupational Safety and Health Administration Regulations, General Safety and Health Provisions” (see Section 1A.11).⁷

As alluded to in parameter E, different safety organizations have input into worker safety at road construction sites. The Occupational Safety and Health Administration maintains a webpage devoted to safety at road construction sites,⁸ and the National Institute for Occupational Safety and Health maintains a webpage with numerous data tables and safety analyses related to work zones.⁹ Several private institutions are involved in worker safety at road construction sites as well, chief among them the National Work Zone Safety Information Clearinghouse.¹⁰

Since 1995, the CFOI has been able to identify fatal occupational injuries of all types that occur at a road construction site through classification of the location of the fatal incident. The CFOI uses multiple source documents to identify and detail all fatal injuries incurred on the job in the United States and is generally considered to be the most complete source of fatal occupational injury data in the nation.¹¹

Passing through

Of the 962 fatal occupational injuries incurred at road construction sites from 2003 to 2010, 122 (13 percent) were incurred by workers passing through the site rather than working at it. Approximately 37 percent occurred between 10:00 p.m. and 5:59 a.m. Truck drivers accounted for the vast majority of

these incidents: 83 (68 percent). About 82 percent of the truck driver incidents involved a tractor-trailer.¹²

Almost 70 percent of passing-through incidents were collisions involving either vehicles or mobile equipment going in the same direction or a vehicle or mobile equipment striking a stopped vehicle or mobile equipment. While 35 percent of all highway collisions involving vehicles or mobile equipment were attributable to these events from 2003 to 2010, they accounted for 89 percent of highway collisions between vehicles or mobile equipment at road construction sites. Twenty-nine deaths resulted from crashes that involved three or more vehicles or pieces of mobile equipment.

While accounting for 15 percent of all fatal occupational injuries at road construction sites, Illinois, Tennessee, Indiana, and Arkansas accounted for 41 percent of fatal occupational injuries to truck drivers passing through road construction sites. (See table 3.)

Table 3. Fatal occupational injuries at road construction sites, all workers and truck drivers passing through the work zone, 2003–2010

State	Number (percent) of all road construction site fatal occupational injuries	Number (percent) of truck drivers
Texas	104 (11)	5 (6)
Illinois	50 (5)	9 (11)
Pennsylvania	49 (5)	7 (8)
California	41 (4)	—
Tennessee	38 (4)	8 (10)
Indiana	32 (3)	11 (13)
Colorado	27 (3)	5 (6)
Arkansas	22 (2)	6 (7)

Note: Data for all years are revised and final. Dashes indicate no data reported or data that do not meet publication criteria. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

Source: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

Working onsite

Approximately seven out of every eight workers who incurred a fatal occupational injury at a road construction site were working at the site at the time. The largest single event that led to fatal occupational injuries for these workers was being struck by a vehicle or mobile equipment. In the 8-year period from 2003 to 2010, 442 workers (53 percent) were killed at the site after being struck by a vehicle or mobile equipment.

Workers are roughly as likely to be struck by construction- or maintenance-related equipment (dump trucks, bulldozers, graders, etc.) as by cars, vans, tractor-trailers, buses, and motorcycles. Workers were fatally struck 152 times by construction- or maintenance-related equipment and 153 times by the other vehicles.¹³

Vehicles or mobile equipment that was backing up posed a particular hazard. Of the 143 cases in which a worker was fatally struck by a backing vehicle or mobile equipment, 84 involved a dump truck striking the worker. (See table 4.) This statistic is particularly notable because section 6D.03, subpart D,

of the MUTCD specifically identifies limiting backing-up maneuvers as a factor in minimizing worker risk.

Table 4. Fatal occupational injuries incurred by workers at road construction sites from being struck by a vehicle or mobile equipment that is backing up, by type of vehicle or mobile equipment, 2003–2010

Vehicle or mobile equipment ⁽¹⁾	Fatal occupational injuries
Total	143
Dump truck	84
Truck (other than dump)	29
Pickup	4
Semi, tractor trailer	8
Water	6
Cement	4
Grader, leveller, planer, scraper	7
Steam roller, road paver	6
Front end loader	3
Street sweeping and cleaning machinery	3

Notes:

⁽¹⁾ Based on the BLS Occupational Injury and Illness Classification Manual.

Note: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

Source: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

Back-up alarms were noted in 39 cases in which the worker was struck by a backing vehicle or mobile equipment. Twenty-five workers were struck by a vehicle or mobile equipment with a functioning back-up alarm; in 17 cases, the vehicle was a dump truck. Of the 14 workers who were struck by a vehicle or mobile equipment without a back-up alarm or with a nonfunctioning back-up alarm, 11 were struck by a dump truck.

Workers were flagging or performing other traffic control duties in 92 cases. Of these workers, 20 were noted as wearing reflective or brightly colored clothing, such as vests, to increase visibility. Only 32 of the workers were employed as flaggers; the other 60 worked in other occupations, such as construction laborers (23), highway maintenance workers (9), and operating engineers (7).

Sixteen workers were killed by a drunk driver. Six of these cases occurred on a Friday or Saturday, and five of the six occurred in the early morning hours.

Transportation incidents other than a worker struck by a vehicle or mobile equipment accounted for 128 deaths. (See table 5.)

Table 5. Fatal occupational injuries incurred by workers at road construction sites involved in a transportation incident other than being struck by a vehicle or mobile equipment, 2003–2010

Event ⁽¹⁾	Fatal occupational injuries
Total	128
Overturn	50
Steam roller, road paver	22
Bulldozer	6
Loader	4
Grader, leveller, planer, scraper	3
Dump truck	3
Fall from vehicle or mobile equipment	32
Grader, leveller, planer, scraper	5
Bulldozer	3
Pickup truck	4
Collision (decedent operating vehicle or mobile equipment below)	37
Pickup truck	9
Steam roller, road paver	4
Bucket or basket hoist—truck mounted	4
Grader, leveller, planer, scraper	4
Automobile	3

Notes:

⁽¹⁾ Based on the BLS Occupational Injury and Illness Classification Manual.

Note: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

Source: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

Other notable incidents having to do with transportation-related deaths incurred by workers who were working at a road construction site include the following:

- Five workers were killed when the bucket truck they were in was struck by another vehicle. In each case, the worker fell from the bucket truck.
- Five workers were killed when they fell from a truck as they were setting up or removing traffic control devices such as signs and cones.
- Three workers were killed when the mobile equipment being used by the worker was struck by a train.

In 51 cases, a worker at a road construction site was fatally injured after being struck by a falling object. Workers were struck by a tree seven times; by structural metal materials six times; and by pipes,

ducts, and tubing four times. In nine cases, the worker was struck by a falling object that fell from or was put in motion by a crane. In six cases, an object fell from or was put in motion by a backhoe.

Twenty-one workers were killed when a vehicle or mobile equipment that was not in normal operation struck them.¹⁴ In nine cases, the vehicle or mobile equipment rolled or slid down a decline. Trench collapses were the cause of 20 worker deaths at road construction sites from 2003 to 2010.

Falls to lower level accounted for 45 deaths among workers at road construction sites. In 8 cases, it was noted that the worker was not wearing or had removed fall protection equipment. In 6 other cases, the worker was employing fall protection equipment but failed to tie off to a safety line. Of the 14 cases in which fall protection was either not in place or not correctly used, all occurred at bridge or overpass construction sites.

Almost three-quarters (37) of the 45 fatal falls involved workers at a bridge or overpass construction site. In 35 cases, the height of fall was noted; the median height from which a worker fell was 39 feet.

A total of 39 workers died from contact with electric current while working at a road construction site. Most (35) of these deaths involved contact with overhead power lines. In 26 of the cases involving contact with power lines, the worker contacted the lines indirectly; that is, another object became electrified when it came in contact with the power lines and subsequently electrocuted the worker. (See table 6.)

Table 6. Fatal occupational injuries incurred by workers at road construction sites from indirect contact with power lines, 2003–2010

Object that contacted power lines ⁽¹⁾	Fatal occupational injuries
Total	26
Crane—mobile, truck, rail-mounted	5
Bucket or basket hoist—truck mounted	5
Pile driver, tamping machinery	3

Notes:

⁽¹⁾ Based on the BLS Occupational Injury and Illness Classification Manual.

NOTE: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with state, New York City, District of Columbia, and federal agencies, Census of Fatal Occupational Injuries.

SEVERAL DIFFERENT ELEMENTS outlined in the MUTCD correspond closely to the most frequent fatal occupational injuries at road construction sites. The category “Workers being struck by construction equipment” is a hazard stressed in section 6D.03: “TTC zones present temporary and constantly changing conditions that are unexpected by the road user. This creates an even higher degree of vulnerability for workers on or near the roadway.”¹⁵ The large number of collisions involving vehicles or mobile equipment in which one vehicle is stopped indicates that particular attention should be given to sections 6C.04, “Advance warning area,” and 6C.05, “Transition area,” which outline the procedures for alerting drivers approaching the road construction site. Fatal occupational injuries at road construction sites will continue to be a focus of safety organizations in outreach to workers and drivers alike.

Notes

1 According to the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). Visit <http://www-fars.nhtsa.dot.gov/Main/index.aspx> for more information.

2 Data on fatal occupational injuries are taken from the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI), which identifies, details, and publishes data on all fatal occupational injuries that occur in the United States. For more background on the CFOI, see *BLS Handbook of Methods*, Chapter 9, "Occupational safety and health statistics" (U.S. Bureau of Labor Statistics, September 5, 2012), http://www.bls.gov/opub/hom/homch9.htm#survey_fatal. Additional data from the CFOI can be found in *Injuries, illnesses, and fatalities: Census of Fatal Occupational Injuries (CFOI)—current and revised data* (U.S. Bureau of Labor Statistics, August 22, 2013), <http://www.bls.gov/iif/oshcfoi1.htm>.

3 See Stephen Pegula, "Fatal occupational injuries at road construction sites," *Monthly Labor Review*, December 2004, pp. 43–47, <http://www.bls.gov/opub/mlr/2004/12/ressum2.pdf>, and "Fatal occupational injuries at road construction sites, 2003–07," *Monthly Labor Review*, November 2010, pp. 37–40, <http://www.bls.gov/opub/mlr/2010/11/art3full.pdf>.

4 Data from the narratives were compiled expressly for use in this analysis and are not official products of the CFOI. The data were verified by an independent reviewer.

5 See *Manual on uniform traffic control devices* (U.S. Department of Transportation), <http://mutcd.fhwa.dot.gov/>. For the full publication, see *Manual on uniform traffic control devices for streets and highways* (U.S. Department of Transportation, 2009), <http://mutcd.fhwa.dot.gov/pdfs/2009/mutcd2009edition.pdf>. For more information on the MUTCD, see *Manual on uniform traffic control devices (MUTCD): 2009 MUTCD, original, December 2009* (U.S. Department of Transportation, 2013), http://mutcd.fhwa.dot.gov/kno_2009.htm.

6 See *Manual on uniform traffic control devices for streets and highways*, p. 552.

7 Ibid., p. 564.

8 See *Highway work zones and signs, signals, and barricades* (U.S. Department of Labor, Occupational Safety & Health Administration), http://www.osha.gov/doc/highway_workzones/.

9 See "Highway work zone safety," *Workplace safety & health topics* (National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, June 6, 2013), <http://www.cdc.gov/niosh/topics/highwayworkzones/>.

10 The organization's website is at <http://www.workzonesafety.org/>.

11 For more information on how work relationship is defined in the CFOI, see *Injuries, illnesses, and fatalities: Census of Fatal Occupational Injuries (CFOI): Definitions* (U.S. Bureau of Labor Statistics, May 5, 2013), <http://www.bls.gov/iif/oshcdef.htm>.

12 In the CFOI, the source of the injury in transportation cases is the vehicle or mobile equipment that the worker was driving or the vehicle or mobile equipment that struck the worker. The secondary source of the injury is either the vehicle or mobile equipment with which the worker's vehicle or mobile equipment collided or another contributing object. For more information on the source and secondary source, see *Injuries, illnesses, and fatalities: Occupational injury and illness classification manual* (U.S. Bureau of Labor Statistics, March 6, 2012), <http://www.bls.gov/iif/oshciics.htm>.

13 Based on the *Occupational injury and illness classification manual*, construction- or maintenance-related equipment is defined as anything falling into the 32* source series, "construction, logging, and mining machinery," as well as source 8252, dump trucks. For the full manual used for 1992–2010 data, see *Occupational injury and illness classification manual* (U.S. Bureau of Labor Statistics, September 2007), http://www.bls.gov/iif/oiics_manual_2007.pdf.

¹⁴ Normal operation is when the vehicle or mobile equipment is being operated by someone for a transportation purpose. Examples of vehicles or mobile equipment not in normal operation are a truck that slips into gear with no one at the wheel, a bulldozer that stalls and slides down a hill, and a front end loader with the parking brake not engaged and that rolls down a decline.

¹⁵ See *Manual on uniform traffic control devices for streets and highways*, p. 564.

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